

**Design, Development and Evaluation of an
Interactive educational multimedia package
to enhance distance learning of
abstract concepts in science**

Dona Geetha Udayangani Kulasekara

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**Educational Technology Division
Open University of Sri Lanka**

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Abstract

This thesis reports how an interactive multimedia (IMM) instructional material suited to Sri Lankan distance learners was designed and developed, as a supplementary study package to enhance distance learning of abstract concepts in science through the selection of a concept in Microbiology, and how learners perceived it as a learning package. This IMM was specially designed to support the Open and Distance learners who are studying Microbiology as a part of the B. Sc. Degree program at the Open University of Sri Lanka (OUSL). The purpose of developing this IMM was to explain the dynamic, abstract genetic concepts which are hard to comprehend using lengthy explanations in print course material, as surfaced from course evaluations.

A comprehensive literature review was carried out in harnessing available literature related to Open and Distance Learning in general, and to multimedia designing and evaluation, in order to carry out a systematic study on design, development and evaluation of multimedia instructional material for distance learning. When developing this IMM learning package, emphasis was placed on instructional design, interface design, navigational design and motivational design in particular, in order to enhance active learning through self exploration. Instructional design was based on Gagne's nine events of instructions, and Mayer's cognitive theory of multimedia learning was harnessed in the design of verbal and pictorial information. Guidelines and principles proposed by Phillips & DiGiorgio and Alessi & Trollip were considered for navigational and interface design, while Keller's ARCS motivational model was followed in designing motivational strategies.

This research study was carried out in two parts. First part is the designing of the IMM package (the product) and the second is the evaluation of the IMM package with the end users, the learners. Therefore, the study was undertaken by following the classical ADDIE instructional design framework. Its five phases (analysis, design, development, implementation, and evaluation) facilitated the progression of study from instructional planning until implementation of the final product.

Utilising the theories, principles, rules and guidelines explored through the review of literature, the IMM was integrated with different instructional design features, exploiting the strength of the multimedia authoring software 'Macromedia Director'. As a result IMM was integrated with different media elements, such as text, audio, graphics and animations, while allowing the learner to control the learning environment. To explain and visualize dynamic abstract processes over time, animations with narrations were extensively used. Facilitating learners to achieve a meaningful learning experience, the IMM was also integrated with various pedagogical features such as objectives, pre-requisite knowledge, self assessment activities with immediate feedback, an interactive glossary of technical terms, a summary, navigational guidance etc. In addition the IMM was also included with various motivational strategies, to gain learners attention and maintain it throughout.

The evaluation/the learner perceptions on learning with the IMM were gathered through quantitative and qualitative research methods by means of a questionnaire, interviews and observations. Questionnaire comprised of questions related to learners' background information, instructional design, interface design, navigational design and motivational aspects of IMM. Responses were gathered on four point Likert scale (strongly disagree [1] to strongly agree [4]). Interview also addressed the same themes and in addition learner reflections on learning with the IMM. While each learner was studying the IMM package, they were observed and recorded using an observational schedule. Triangulation of research methods (questionnaire, interview and observations) were used to achieve reliable evidence and validate the results.

This study was conducted with learners who were following BTU2104 *Principles of Microbiology* course at OUSL. All registered learners (165) were informed of the evaluation process and the quantitative study was carried out with all 42 learners responded. In the qualitative study sample size was restricted to first 30 as data collection achieved a theoretical saturation. Frequencies were computed for quantitative data and content analysis was carried out for qualitative data.

Evaluation revealed learners' intrinsic feeling of success and enjoyment in learning with the IMM. Animations with background narration were perceived as excellent learning object for self learning of abstract dynamic processes. Self assessment activities with interactive feedback have become more responsive to them allowing them to check their own performance while learning. Visual attractiveness and learning with supportive media with user controls were among the main motivational features. Learners never felt the time passing by and revealed their satisfaction as they could do a personalized study. They accepted learning with IMM as a rewarding experience and requested to integrate more IMM material to deal with other concepts in the same course and other courses too.

One major drawback pointed out by students was the design of IMM with regard to inappropriate placement of objectives in the IMM. Moreover, they suggested adding more self assessment activities and more relevant pre-requisite knowledge into the IMM to improve the package.

Conclusions and recommendations deal with the improvements to be made to the product before releasing it to the learners as a supplementary material to the Microbiology course, and how the researcher is going to apply her knowledge gained, by producing some more IMM packages to the course and also disseminating her knowledge to the fellow staff in developing such IMM material.

Overall, the findings of this study confirms the use of systematically designed, learner centred, interactive multimedia instructional material enhance distance learning of abstract sciences.